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ACCOUNTING INFORMATION SUPPORT FOR EFFECTIVE MANAGEMENT OF MINING INDUSTRY ENTERPRISES

ABSTRACT

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I.GENERAL CHARACTERISTIC OF THE DISSERTATION

1.Relevance. Topics related to accounting challenges in mining industry enterprises are becoming increasingly relevant in the context of growing pressure for transparency and business sustainability. The specific nature of the sector, which involves the depletion of natural resources, high capital expenditures, and significant environmental responsibilities, requires a thorough rethinking and enhancement of traditional accounting models. In this regard, accounting serves as a key source of information essential for the effective management and integration of environmental and social aspects into strategic decision-making.

2.Degree of development of the problem. Despite its significance, accounting-related issues in the mining industry remain insufficiently systematized in Bulgarian scientific literature. This is particularly true with regard to environmental accounting and corporate responsibility. Existing studies are often fragmented and do not offer comprehensive, integrated solutions for the accounting treatment of specific operations such as the acquisition of mining rights, recultivation, and waste. The present dissertation builds on the existing theoretical framework. It proposes a comprehensive accounting approach adapted to the contemporary requirements of a market-oriented and environmentally responsible mining industry.

3.Research thesis. Through the improvement and integration of specific accounting approaches and methods (particularly in the areas of environmental cost accounting and activity-based costing), a detailed and strategically relevant accounting information base can be established to support effective management, investment decision-making, and the achievement of sustainability in mining industry enterprises.

4.Object and subject. The object of the research is the accounting system of mining industry enterprises.[1] The subject of the study is the methodology and organization of accounting for specific assets, costs, and environmental liabilities, with the aim of improving information support for decision-making in the sector.

The selection of the mining sector (Sector B) as the focus of the study is based on its importance to the national economy and the complex challenges it generates, including:

- ✓ long-term and capital-intensive nature of investments (acquisition of rights, heavy equipment);
- ✓ specific product;
- ✓ high regulatory burden in terms of ecology and the obligation to recultivate land;
- ✓ need to adapt to international standards and environmental reporting.

5. Main goal and objectives. The aim of the study is to propose an integrated approach for environmentally oriented accounting information support for strategic management and sustainability. The objectives of the study are:

First, to outline the specific characteristics of operations in mining industry enterprises;

Second, to analyze the current state and characteristics of the accounting system in mining enterprises, including the applicable international standards;

Third, to justify and propose concrete methodological and organizational recommendations for accounting for specific assets (mining rights) and liabilities (recultivation and waste management);

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[1] **Sector B Mining and Quarrying**
08 Quarrying of non-metallic minerals
08.1 Quarrying of stone, sand, and clay
08.11 Quarrying of building and decorative stone, limestone, raw gypsum, chalk, dolomite, and shale
08.12 Quarrying of crushed stone, gravel and sand, extraction of clay and kaolin
(Institute, 2024, p. 44)

Fourth, to explore the possibilities for integrating environmental accounting (ECA) into the budgeting process (OPEX and CAPEX) in order to form a green capital budget and link accounting information to the enterprises' ESG reporting.

6.Methodology of the research. The following methods were used in this study to achieve the set goal and objectives: historical-logical method, comparative analysis, systematic approach, economic-accounting analysis, modeling method, benchmarking, gap analysis.

7.Restrictive conditions. The study is limited by several key factors. It focuses on the extraction of non-metallic minerals in Bulgaria and is constrained by the absence of a unified national regulatory framework for accounting for environmental liabilities, which necessitates the modeling of recommendations for internal corporate adaptation. Furthermore, it is based primarily on financial reporting of costs rather than a comprehensive forecasting and analytical system for environmental risks. The presentation in the current study is aligned with the applicable national regulatory framework as of 31 December 2025.

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III. A BRIEF SUMMARY OF THE DISSERTATION

INTRODUCTION

The introduction presents the relevance of the research. The research thesis is formulated. The object, subject, goal, and research objectives are defined. The methodology used in the research is described.

Chapter one. CURRENT STATE AND TRENDS IN ACCOUNTING IN MINING INDUSTRY ENTERPRISES

1.1. Property and operations of mining industry enterprises as objects of accounting

As a result of targeted theoretical and applied research, it can be reasonably concluded that the specific characteristics of mining activities, such as geographical dependence, long-term investments, and environmental impact, create specific challenges and opportunities for the sector. The effective management of the analysed factors requires a combination of strategic planning, innovation and responsibility towards the environment and society. This also highlights the need for adequate accounting and management approaches aimed at ensuring transparency, efficiency and sustainable development.

Accounting in the mining industry covers a wide range of items. These reflect the specific nature of the activity (from large capital expenditures and the significant role of non-current assets to contemporaty environmental and regulatory requirements), the scale of business operations, and production processes. These require an adequate approach to reporting for non-current assets, investments, and capital expenditures.

The accounting of reporting entities in the mining sector is strictly regulated by national legislation, international standards, and specific industry guidelines that ensure the transparency, comparability, and reliability of financial statements. The unique characteristics of mining activities require compliance with a number of regulations that recognise the economic value of natural resources, investments in mining facilities, and the environmental liabilities of enterprises

Accounting for assets, expenses, and revenues, as well as managing provisions, requires understanding and applying the provisions of the national and

international legal framework. All this ensures legal and regulatory compliance as well as sustainable and effective management of enterprises in the sector.

Regular geological analyses and updates of natural resource reserves are as important as changes in resource valuation, requiring flexibility in accounting policies. Taking into account all costs associated with collecting up-to-date information on natural resource reserves in the earth's crust that can be extracted, it is clear that mining industry enterprises need to have a highly developed data analysis and management system. Such a system integrates geological, economic, and accounting information into a unified management tool.

1.2. Specific features of the accounting system in mining industry enterprises

Quarrying of non-metallic minerals determines certain specific features in the design and operation of the accounting system in enterprises engaged in this activity, as follows:

- ✓ Accounting for non-current assets. Specific accounting is required for quarrying rights (quarries) and heavy equipment. A depreciation method is applied, often based on the unit-of-production approach or a functional depreciation method.
- ✓ Cost Calculation. Cost price is a complex economic category. It includes direct quarrying costs (fuel, labor) and general costs (depreciation, rents, license fees). Reliable cost calculation and internal control require the integration of environmental costs and land recultivation obligations into the cost price by quarrying units, rather than treating them as external costs.
- ✓ Recognition of provisions – respectively, environmental restoration costs. Enterprises should recognise provisions for future recultivation. This is reflected as a liability on the balance sheet.

- ✓ Inventory management. Accurate accounting for inventories of raw materials, supplies, work-in-progress, and finished products is required.

The accounting system in mining industry enterprises should reflect the capital intensity and geographical dispersion of economic activity. The organization of accounting is essential for the accuracy, timeliness, and reliability of information. In this regard, emphasis is placed on:

- Cost and Cost Calculation Analysis. The actual cost per unit of quarrying is calculated. The management unit uses the analysis to monitor efficiency. It reports deviations from the standard cost price by production centers.
- Assessment of Capital Expenditures (CAPEX). The accounting system provides data on cash flows and depreciation forecasts. The management department evaluates the profitability of new quarries using NPV (Net Present Value).
- Budgeting and Forecasting. It is based on historical data on operating expenses (OPEX). The accounting system ensures the accuracy of input data for long-term financial modeling.
- Performance Measurement. Key Performance Indicators (KPIs) are employed to measure performance. They include metrics such as Return on Equity (ROE), cost per ton, etc. The aim is to enhance the reliability of these management metrics.

Effective interaction requires an integrated ERP (Enterprise Resource Planning) system. It ensures the timely transfer of accounting information. Through this system, well-founded management decisions in the mining industry are supported.

The accounting system in mining industry enterprises should ensure accuracy and timeliness. In this context, the focus is on the capital-intensive nature and long-term life cycle of operations. Cost accounting is differentiated by phases: quarrying, exploration, and recultivation.

➢ Quarrying costs reflect all materials, labor, and other resources used for the extraction of minerals. Costs are classified as direct and indirect (overhead):

-Direct Costs. Directly related to quarrying activities. They include materials (e.g. explosives), labor, energy, etc. They are recognized as current period expenses and are calculated as part of the cost of the extracted material

-Indirect Costs. They cannot be directly attributed to a specific quarrying process (e.g. equipment maintenance, administration). They are allocated proportionally to the extracted material.

➢ Cost Grouping Method for Determining Cost. The full costing method is applied, which includes direct costs and a proportional share of indirect production costs.

➢ Work in Progress. Extracted but unprocessed or unfinished quantities of material are accounted for as work in progress. They are presented in the accounting balance sheet as current assets.

Accounting information is integrated with management approaches for cost optimization and efficiency improvement as follows:

✓ Cost Analysis. Detailed classification (direct labor, materials, energy) and allocation of costs using methods such as Activity-Based Costing (ABC) allow for the identification of inefficiencies. The ABC method provides a more precise calculation of the cost of individual activities (extraction, washing, transportation).

✓ Performance Measurement. Operational and financial Key Performance Indicators (KPIs) are used. Cost per unit of extracted material and output per unit of resource are important operational metrics. These are compared with financial indicators (Return on Assets – ROA, etc.) for a comprehensive assessment.

✓ Inventory Management. Analytical methods (ABC analysis) are applied to classify inventories by value and significance. ERP systems provide real-time

tracking. This leads to effective working capital management and a reduction of costs associated with maintaining stock levels.

The integration of accounting data with strategic tools (budgeting, benchmarking) confirms the operational efficiency and sustainability of mining enterprises. Therefore, it can be summarized that, in the long term, the aim is to increasingly integrate sustainability into the corporate strategy of these enterprises.

1.3. Integration of accounting into the strategic approach of mining industry enterprises toward sustainability

The mining industry exerts significant environmental impact, manifested in a wide range of ecological issues (including landscape disruption, water pollution, air quality deterioration, and biodiversity loss). These impacts require a comprehensive approach. On one hand, technical and environmental solutions are needed. On the other hand, precise accounting for the associated costs and provisions for the recultivation of affected sites is essential.

This multifaceted approach requires integrated accounting systems – ones that record both current and future costs of environmental restoration and sustainability. Only in this way can transparency of information and precise planning of provisions/environmental restoration costs be achieved. This is crucial for reducing the negative impact of the mining industry on the environment.

To optimise the benefits of the economic impact of the mining sector, effective strategic management and sustainable accounting are required, including the analysis of revenues and costs, management of price fluctuation risks, and forecasting of future economic benefits. At the same time, enterprises need to integrate ESG principles into their operations to minimise negative long-term effects.

Accounting is instrumental in strategic efforts toward sustainable development. Implementing ESG (Environmental, Social, and Governance) criteria

is an important aspect of transforming accounting systems. By incorporating them into corporate reporting, areas of high environmental and social risk can be identified, and strategies for their effective management can be developed.

Mining enterprises (codes 08.11 and 08.12 according to the Classification of Economic Activities – 2025, CEA 2025) often generate significant carbon and other harmful emissions, which are subject to strict regulatory requirements. One of the traditionally applied mechanisms for managing emissions is the EU Emissions Trading System (EU ETS), which requires enterprises to hold sufficient allowances to cover their emissions. Purchased allowances are usually recognised as intangible assets in accordance with applicable accounting standards, with their value presented in the enterprise's balance sheet until they are used. When the allowances are utilised to cover generated emissions, they are derecognised from assets and recognised as expenses in the income statement. In this way, transparency regarding the enterprise's environmental costs is ensured.

In addition to mandatory emissions costs, many enterprises choose to invest in sustainable technologies to reduce their emissions. Expenses related to the implementation of carbon capture and storage systems or energy efficiency measures can be capitalised as non-current assets. These assets are depreciated over their useful lives, with the investments reducing the carbon footprint and potentially limiting future expenses for purchasing allowances.

Ensuring a safe and healthy working environment is of vital importance for enterprises in the mining industry. In this context, occupational safety-related expenses cover a wide range of activities (from personnel training and the purchase of protective equipment to the implementation of specialised safety management systems).

When implementing certified safety management systems (such as ISO 45001), expenses for development, training, and certification can be capitalised as

intangible assets, provided they meet the recognition criteria under IAS 38 *Intangible Assets*. This applies in cases where such expenses result in long-term benefits, for example, by reducing the risk of accidents or increasing productivity through an improved working environment).

These expenses have a strategic significance in long-term planning. They are presented as part of corporate initiatives for implementing innovations, sustainable resource management, and engagement with community stakeholders. Non-financial reporting enhances transparency and creates added value by building trust and strengthening relationships with stakeholders.

The preparation of non-financial reports is based on established international and regional standards, which ensure consistency and comparability of information. The GRI Standards provide a comprehensive framework for sustainability reporting; the ESRS are standards developed by the European Commission in the context of the new CSRD Directive; the TCFD offers guidance for disclosing climate-related risks and opportunities.

In addition, sustainability reports significantly enhance the reputation of enterprise.

Non-financial information can be defined as an integral part of the contemporary approach to sustainable and responsible management. Given the significant impact of the mining sector on the environment and society, the reporting, accumulation, and presentation of information on enterprises engaged in these activities is particularly important for their accountability and strategic management.

Chapter two. OPPORTUNITIES FOR IMPROVING THE ACCOUNTING OF ECONOMIC OPERATIONS AND PROCESSES SPECIFIC TO THE MINING INDUSTRY

2.1. Accounting aspects of securing quarrying areas in enterprises for quarrying stone, sand, and clay

Quarrying areas and the associated exploitation rights (concessions) constitute the fundamental prerequisite for operations in the sector of non-metallic minerals and raw materials (codes 08.11 and 08.12 according to the Classification of Economic Activities – 2025, CEA 2025). For enterprises engaged in quarrying building and decorative stone, limestone, sand, clay, and kaolin, the acquisition of these areas represents the initial and most significant capital investment.

One of the primary methods for acquiring areas is land expropriation. Expropriated land becomes public state property. According to Article 15 of the State Property Act, these assets are allocated to enterprises free of charge for administration and management. But without the right of disposal.

It is recommended that all expenses related to land expropriation be accumulated in a single operational-cost account. A suggested account title is: *Expropriation Expenses for Quarrying Purposes* or *Expenses for Land Use Change and Expropriation*, or *Expenses Related to Land Expropriation for Quarries*. The most appropriate account title, consistent with regulatory logic and applicable to quarrying of stone, sand, and clay, is *Expropriation Expenses for Quarrying Purposes*. This account is debited with all costs incurred during the expropriation process. It is credited when the process is completed and the acquisition cost (historical cost) of the quarrying area is established. Land acquired through expropriation is considered a depreciable asset, and depreciation is charged based on its estimated useful life.

Empirical research show that the predominant method for obtaining quarrying areas is through leasing. Lease relations are governed by a contract. According to Article 2 of the Agricultural Lease Act, the lessor provides the asset for temporary use, and the lessee is obliged to pay rent. Mining enterprises under codes 08.11 and

08.12 of the Classification of Economic Activities – 2025 (CEA 2025) do not acquire ownership of the land but obtain the right to quarry stone, sand, and clay. They are required to pay rent to the lessor for its use. Land acquired under a lease in quarries is reported as a contingent asset.

In recent years, in the practice of mining enterprises, including those engaged in quarrying stone, sand, and clay, the use of time-limited established usufructuary or contractual rights for the use of land for quarrying has become widespread. These rights provide the enterprise with the opportunity to develop and operate a quarry or other extraction facility on third-party land for a predetermined period. This approach allows flexible investment management and limits initial capital expenditures, which is particularly suitable for quarrying activities due to their high capital intensity and long-term investment horizon.

Such agreements are concluded for a long term and are of a remunerated nature, with the consideration for granting the right to use the quarrying areas often linked to the economic results of the quarry operation. In practice, models exist where the payments due are determined as a percentage of the revenues generated from extraction or as periodic payments spread over time. Although the legal form of these agreements is not identical to a classical lease or rental contract, their economic substance lies in granting control over a specifically designated asset (land or a defined quarrying area) for a specified period in exchange for consideration. This economic characteristic is essential for their accounting treatment.

Depending on the specific terms of the agreement and the applicable accounting framework, the acquired right may be recognized either as an intangible asset or as a right-of-use asset. In both cases, the enterprise is required to apply a consistent and well-founded amortization policy that reflects how the economic benefits from using the quarrying area are consumed over time.

The subsequent accounting of costs related to the time-limited use of quarrying areas is closely linked to the specific characteristics of mining activity. Depreciation expenses or costs related to the allocation of the value of the right of use are included in the cost of the extracted output, insofar as they are directly attributable to the mining process. In this way, an accurate matching of revenues and expenses arising from quarry operations is achieved.

The examination of responsible mining as a concept within the accounting analysis of the acquisition of quarrying areas enables these processes to be interpreted both as legal and economic arrangements supporting mining activity and as a foundation for the long-term sustainable management of natural resources. In contemporary mining industry practice, the concept of responsible mining is increasingly established as an approach that goes beyond the traditional understanding of efficient resource extraction and places emphasis on balancing the economic, environmental, and social dimensions of mining activity. In enterprises engaged in the quarrying of stone, sand, and clay, responsible mining implies not only compliance with regulatory requirements but also the assumption of long-term responsibility for the management of quarrying areas, the environmental impact of operations, and the subsequent recultivation of affected areas.

Empirical observations confirm that, from an accounting perspective, the concept of responsible mining requires an expansion of the scope of analysis of the costs related to the acquisition of quarrying areas. These costs should not be viewed in isolation as an initial investment securing access to resources, but rather as part of a comprehensive economic commitment that includes future environmental and recultivation obligations. In this way, accounting is a means of reflecting the true economic cost of mining, in line with the principles of responsible natural resource management.

The fixed-term use of mining areas, which is economically comparable to control over an asset for a specified period, requires that costs related to future recultivation are recognised at the moment the obligation arises, rather than at the time when the related activities are actually performed. This requires mining enterprises to apply an approach under which environmental and recultivation obligations are integrated into the overall investment assessment of the mining site and are matched with the economic benefits expected from the use of the area over the term of the granted right.

2.2. The concession model in the quarrying of stone, sand, and clay and its accounting dimensions

The concession right for the quarrying of stone, sand, and clay is recognised and accounted for as an intangible asset in accordance with IAS 38 *Intangible Assets*. It is accounted for separately from the tangible assets used in the quarrying process, with its value determined on the basis of the expected future concession payments and the direct costs necessary for its acquisition. For accounting purposes, the opening of a separate account entitled *Concession rights for the quarrying of stone, sand, and clay* under the account *Industrial property rights* is proposed. The account is debited with the acquisition cost or concession consideration and is credited upon amortisation.

From an accounting perspective, the recognition of the concession right increases the value of the intangible asset. At the same time, it reduces the receivables under the concession agreement by the amount of the agreed consideration. The accumulated acquisition costs that were previously recorded separately are simultaneously derecognised. This ensures that all relevant costs are fully included in the carrying amount of the concession right.

For amortisation purposes, it is first necessary to determine the depreciable amount, which corresponds to the carrying amount of the concession right at the

moment of its recognition. The annual amortisation charge is calculated based on the useful life of the deposit and the applicable amortisation rate. The selected method should be applied consistently throughout the entire period of the asset's use.

Given the specific nature of mining activities and the direct relationship between economic benefits and the volume of extracted resources, the units-of-production method or the functional amortisation method are the most appropriate. These methods provide a more accurate allocation of the concession right's carrying amount according to the actual mining activity performed. They also contribute to a more realistic determination of the cost of production.

The concession activity for the quarrying of stone, sand, and clay involves the simultaneous use of intangible and tangible assets, which operate in close economic and technological interconnection. From an accounting perspective, this interconnection is reflected in the joint application of IAS 38 *Intangible Assets* and IAS 16 *Property, Plant and Equipment*, with each standard regulating a different aspect of the assets required to carry out mining operations..

A key element of the interconnection between the two types of assets is that tangible mining assets can only be recognised as such if a valid concession right exists. Without it, they would not be able to generate economic benefits within the enterprise's core operations. Nevertheless, the concession right itself does not include the value of the tangible assets and is not increased by the costs incurred to acquire or construct them. In this way, the enterprise's accounting system recognises two parallel and interconnected assets: an intangible asset – the concession right, and tangible assets – the resources required to carry out mining operations.

One of the current discussion points in the accounting practice of mining enterprises (Sector B Mining and Quarrying) concerns the treatment of costs for exploration and prospecting of new quarrying areas. The accounting treatment of the incurred exploration and prospecting (E&P) costs is important for the accurate and

fair presentation of the financial position of a mining enterprise. The choice between capitalising costs when exploration is successful and expensing them in the event of failure directly affects the enterprise's capital base and reflects the actual investment risk associated with geological exploration. In practice, a successful commercial discovery often serves as the basis for the direct granting of a concession by the state, without the need for a public tender, with the capitalised costs forming the initial carrying amount of the acquired exploitation rights.

The acquired rights for exploration and prospecting of underground resources are recognised as long-term intangible assets. They can be accounted for under the account Industrial property rights, with the sub-account Long-term exploration and prospecting permits for underground resources. Analytical accounting can be carried out either by type of mineral resource – stone, sand, clay, etc., or by the location of the quarrying areas under exploration. The account is debited with the carrying amount of the acquired rights, as well as with any positive revaluation, and credited upon derecognition or the recognition of a negative revaluation.

The costs incurred for exploratory operations are considered research activities. These costs are recognised as current expenses and included in the expenses of the enterprise for the period in which they are incurred. It is advisable to open a sub-account *Costs for geological and exploration studies* under the account *Auxiliary activity expenses*. When capitalising costs for specialised studies, drilling, geological maps, and other related activities, the *Costs for geological and exploration studies* account is debited against the *External services expenses* account (when external contractors are used) or against the sub-account *Geological database* under *Auxiliary activity expenses*.

From an accounting perspective, environmental obligations in concession-based quarrying represent present obligations with future settlement. Their value should be recognised and reported in accordance with IAS 37 *Provisions, Contingent*

Liabilities and Contingent Assets. According to international practice and IAS 16 *Property, Plant and Equipment*, a recognised provision for recultivation is not treated as a separate expense. Instead, it is capitalised as part of the carrying amount of the related mining assets. In the case of concession-based quarrying of stone, sand, and clay, this value relates to the tangible assets used in the extraction process (quarry, overburden, infrastructure) and not to the concession right under IAS 38 *Intangible Assets*.

In each reporting period, the carrying amount of the provision increases with the accrued interest expenses arising from the passage of time. This expense is recognised as a financial cost and is not directly included in the cost of extraction. The capitalised value of the provision is amortised as part of the tangible mining assets. This amortisation expense is included in the production cost of the extracted stone, sand, and clay. In this way, environmental obligations are allocated across the produced output.

2.3. State and optimisation aspects of accounting for recultivation

The costs of recultivation of disturbed areas have a determining impact on operational efficiency and affect the financial result. On one hand, these costs are environmentally significant, while on the other hand, they also have an investment character.

The accounting treatment of costs related to the recultivation of disturbed areas, which are publicly owned, is an essential element of financial reporting for mining enterprises. The need for recultivation represents a legal and environmental obligation, requiring the application of specific accounting approaches:

- Recognition as expenses for future periods (deferred costs). This approach is applied when the recultivation expenditure is associated with subsequent obligations for site maintenance. Since the legal entity that carries out the restoration activities is required to remedy any violations or non-

compliance in the recultivated area over a defined period (usually between 3 and 5 years), the cost is initially capitalised. It is then recognised in the current financial result gradually, over the following reporting periods, as the mandatory maintenance of the site is performed.

- Financing and grants. Enterprises can secure additional financial resources to fulfil their environmental obligations through external financing. This is often provided in the form of grants from national or European programs, administered, for example, by the Ministry of Agriculture and Food. The received funds are recognised as targeted financing income or classified as deferred income. They are used directly to cover the costs related to the recultivation and restoration of the sites.
- Advance contributions to centralised funds. In international practice, the management of recultivation obligations in mining enterprises is often carried out through financial mechanisms, such as site closure funds or requirements for advance financial provisioning. It should be emphasised that, within the Bulgarian regulatory framework, there is no central fund or industry-wide mechanism in which enterprises are required to make mandatory advance contributions for recultivation. Financial and environmental obligations are regulated individually within the licensing and concession regimes under the Subsoil Resources Act and the relevant subordinate legislation.
- Creation of a reserve or provision. Establishing a reserve or provision for recultivation obligations in accordance with IAS 37 *Provisions, contingent liabilities and contingent assets* is a common practice. Under this approach, the enterprise recognises a current expense and a corresponding liability for future recultivation, without the need for an actual payment at the time. The main advantage is that it achieves a more accurate matching of revenues

and expenses. The obligation is recognised in the period in which the site disturbance occurs, without burdening the production cost with the full value of the future expenditure.

The main objective of accounting for recultivation costs is to ensure that they are systematically and continuously recognised throughout the entire site recultivation period. This allows financial reporting to reflect the actual use of resources and the status of the enterprise's environmental and recultivation obligations. According to accounting theory and practice, these costs can also be recognised during the production process, similar to other production costs, ensuring their integration into the overall production cycle. Essentially, they are included in the cost of extracted materials – stone, sand, and clay – and thus allocated proportionally to the volume of extraction. This practice ensures that the product cost accurately reflects all expenses related to extraction and subsequent site recultivation, while also providing a basis for precise management of environmental costs and planning future investments in the sustainable use of the sites.

To establish a comprehensive and consistent accounting policy for recultivation costs, two key measures are recommended. The first is granting ownership rights over the land to mining enterprises. This means that quarries or mining sites (according to codes 08.11 and 08.12 of the 2025 Classification of Economic Activities) should acquire ownership of agricultural plots, including those from reserves or former owners, at fair market value. In this way, enterprises not only manage and control the sites but also gain the ability to dispose of them after recultivation, which strengthens their capital base and allows effective planning of investments in environmental protection activities.

The second recommendation is the establishment of a separate reporting object for recultivated sites. This object is included in the enterprise's long-term assets, measured at fair value, and categorized in accordance with the requirements

of the Regulation on the Categorization of Agricultural Land when changing its purpose. Analytical accounting of recultivated sites allows for separate tracking of costs related to technical and biological recultivation, ensures transparency in calculating the production cost of extracted materials, and provides a basis for control, planning, and reporting.

Chapter three. ENVIRONMENTAL ASPECTS OF MINERAL RESOURCE MINING – ACCOUNTING TREATMENT AND CORPORATE RESPONSIBILITY

3.1. Accounting information and tax treatment of waste generated by the mining industry

Effective waste management is linked to the application of a clear regulatory, accounting, and tax framework based on the Waste Management Act and the Value Added Tax Act (VAT Act). Pursuant to Chapter 19a of the VAT Act and Annex No. 2 thereto, a special taxation regime applies to certain types of waste and related services (household, industrial, and construction waste), namely the reverse charge mechanism. Under this regime, value added tax is not charged by the supplier but is self-assessed by the recipient of the service, provided that the recipient is a person registered for VAT purposes.

The informational value of accounting records related to waste management activities is reflected in their dual managerial function – financial and environmental. On the one hand, they ensure compliance with the regulatory framework and tax reporting requirements, and on the other, they support managerial decision-making through the identification and analysis of environmental costs.

With regard to the relationship between waste management and non-financial reporting, waste management in enterprises from the mining industry should not be viewed solely as a regulatory or tax obligation. In practice, it constitutes an element of the system of sustainable corporate governance and non-financial reporting. In

the context of the requirements of the Corporate Sustainability Reporting Directive (CSRD) and the European Sustainability Reporting Standards (ESRS), information on generated, recovered, and disposed waste becomes an important indicator of the environmental performance of enterprises.

In order to ensure the accuracy and reliability of waste reporting, enterprises classified under codes 08.11 and 08.12 of the CEA - 2025 should be subject to regular internal and external audits. These audits examine compliance with applicable standards and regulations, as well as the correct measurement, accounting recognition, and management of waste. Internal audits are manifested through reviews of the accuracy of records related to waste management, analyses of the effectiveness of waste management practices, and assessments of compliance with environmental standards. Auditors may provide recommendations for improvement aimed at reducing the risk of losses and breaches of environmental legislation.

3.2. Contemporary accounting approach to the recognition of environmental protection and recultivation costs and provisioning

For the purposes of accurate accounting recognition, it is necessary to classify environmental costs precisely, especially in the specific context of the mining industry (codes 08.11 and 08.12 of CEA - 2025). The primary distinction follows the logic of the expense's occurrence:

1. Costs for restoring disturbed balance. In the mining sector, this includes provisions for recultivation and dismantling of facilities, which represent deferred environmental care and are a direct result of the commitment to restore the site after the completion of mining activities. The accounting recognition of these costs is linked to the establishment of provisions in accordance with IAS 37 *Provisions, Contingent Liabilities and Contingent Assets*.

2. Costs for preventing disturbances (preventive). In a broad sense, these include all capital (Capital Expenditure – CAPEX) and operational (Operational Expenditure – OPEX) costs related to the development and commissioning of environmentally protected sites.

A significant trend is the shift in focus from post-treatment environmental care to integrated solutions. Increasingly, pollution is prevented through modernisation and optimisation of core production processes and facilities, making preventive costs comprehensive. For accurate allocation of these costs in the total production cost, they should be precisely classified and associated with specific environmental measures or assets, ensuring their direct connection to the production cycle.

Effective management of Environmental Protection Costs (EPC) in mining enterprises requires not only compliance with legal obligations for subsequent recognition but also the establishment of a structured system for cost calculation, ensuring preventive control over current expenditures. Before being systematised and integrated into production costs, especially when introducing new technologies, it is essential to apply monitoring of the necessity and accuracy of each cost.

The process of developing the material and energy flow model is systematic. It includes defining the system boundaries, identifying cost centres (the location where the cost occurs) and mapping all flows (materials, water, energy, waste, and emissions).

The effective integration of cost calculation across the stages of the production cycle (costs at individual phases of the value chain) into the accounting system of the mining enterprise requires a set of coordinated actions. These include correcting weaknesses in existing cost standards, optimising the data recording process, improving documentation, and systematising costs for reporting purposes.

The accounting of environmental costs in the mining sector is fully harmonised with IAS/IFRS, with sector-specific issues (recultivation and site

closure) addressed through the application of the relevant standards. IAS 16 *Property, Plant and Equipment* and IAS 37 *Provisions, Contingent Liabilities and Contingent Assets* form the foundation for accounting treatment. The first regulates the capitalisation of dismantling and restoration costs in the carrying amount of long-term assets, while the second governs the recognition and measurement of provisions for future environmental obligations. Additionally, IAS 38 *Intangible Assets* and IAS 36 *Impairment of Assets* regulate the accounting of mining rights as intangible assets and their periodic impairment, influenced by changes in environmental requirements. For the recognition of decommissioning obligations and the management of specialised funds, the guidance of IFRIC 1 *Changes in Existing Decommissioning, Restoration and Similar Liabilities* and IFRIC 5 *Rights to Interests Arising from Decommissioning, Restoration and Environmental Rehabilitation Funds* is applied.

3.3. On the Transition to Sustainability and Environmental Reporting

A gap analysis is applied. Its methodology allows for the simultaneous definition of a strategic vision for integrated environmental reporting and the precise measurement of functional gaps in the mining sector (Sector B of the Classification of Economic Activities - 2025) in Bulgaria. The objective is not merely to summarise the identified discrepancies, but to generate a targeted framework of recommendations aimed at achieving full operational alignment between the financial-accounting system and the imperatives of corporate sustainability.

The transition to sustainable reporting requires the establishment of a closed information cycle that links environmental information with financial results. This cycle forms the basis for “Green Budgeting” and managerial reporting.

A model for addressing existing gaps

Identified Gap (current state)	Strategic linkage	Accounting outcome (desired state)

Homogeneous provisioning under IAS 37 *Provisions, Contingent Liabilities and Contingent Assets*, without linkage to a specific asset or risk	Transition to batch-analytical accounting – provisioning by concession/mine with individual discounting analysis.	Financial reliability – accurate presentation of environmental liabilities in the balance sheet.
Environmental costs are general, with no linkage to cost of production or cost centers.	Chart of accounts update – introduction of analytical accounts for the "Cost Accounting" of environmental fees.	Management relevance – opportunity for green pricing and profitability analysis.
Lack of linkage between operational (non-financial) data and accounting software.	Technological integration – development of an interface between Environmental Systems and ERP/Accounting.	Reliability of environmental accounting information – automated and verifiable generation of integrated KPIs and ESRS reports.

3.4. Integration of environmental accounting information into the budgeting process

The implementation of international best practices under Bulgarian conditions requires the establishment of internal environmental compliance standards. These standards should go beyond the minimum legal requirements, transforming environmental responsibility into a competitive advantage and an investment criterion.

Comparative analysis and adaptation of a "green" capital budget

Key element	Conceptual essence	Financial instrument for integration	Application in Bulgarian mining enterprises
"Carbon price"	Internal mechanism for managing climate risk and incentivising decarbonization	Adjusted NPV and Internal Rate of Return (IRR) of the project	Mandatory application of the Shadow Carbon Price in the evaluation of all new CAPEX projects with a service life over 5 years.
Recultivation provisions	Accounting for the full life-cycle cost of the mine.	Discounting of future expenditures and creation of a provision fund (in accordance with IAS 37 *Provisions, Contingent Liabilities and Contingent Assets*).	Integrated budgeting of provisions in the annual CAPEX plan; not limited to accounting recognition only.
Energy transition	Turning energy efficiency into a capital asset.	Green CAPEX (investments in RES, hybrid systems) with a preferential NPV threshold.	Creation of a separate budget line for investments aimed at reducing the energy intensity of mining operations.

Environmental compliance	Establishing ESG thresholds for investment approval.	ESG risk assessment matrix and environmental risk factor.	Development of internal environmental compliance standards linked to concession plans and long-term sustainability objectives.

With the implementation of the ECA methodology in Bulgarian mining companies, operational accounting will go through a significant transformation.

Integration of environmental cost accounting (ECA) into the operational budget (OPEX)

ECA component	Conceptual essence	Budgetary mechanism	Application in Bulgarian mining enterprises
Preventive costs	Investments to avoid future environmental damage (e.g., training, cleaner technologies).	Separate cost centers for "prevention" with priority funding.	Zero-based budgeting for preventive activities to ensure their legitimacy and necessity each year.
Hidden costs (FCA)	Costs not directly labeled as "environmental" (e.g., depreciation of treatment facilities, personnel).	Allocation of costs to specific environmental processes.	Development of internal guidelines for allocating hidden costs and including them in the production cost.
Waste management	Budgeting aimed at reducing waste and increasing recycling.	Budgeting based on waste quantity and quality, linked to financial incentives.	Implementation of KPIs to reduce resource intensity in the operational budgets of production units.
Budgetary control	Linking financial performance with environmental efficiency.	Variance analysis based on EPIs and financial data.	Implementation of an internal environmental audit system to evaluate budget performance against environmental objectives.

Through benchmarking international best practices for integrated reporting, it is established that financial and non-financial information should be seamlessly connected. Such integration would transform environmental accounting information into a strategic asset (ensuring regulatory compliance, managerial transparency, and trust from investors and the public).

IV. CONCLUSION

Through the application of a scientifically grounded research framework, the aim of the study has been achieved, and the dissertation thesis can be considered successfully defended. The logical structure of the exposition provides a detailed, reliable, and strategically useful accounting and information base. The proposed integrated approach establishes the necessary structural foundation for positioning accounting as a determining factor in sustainable corporate management and the implementation of contemporary requirements for environmental reporting.

VI. REFERENCE OF THE SCIENTIFIC AND SCIENTIFIC AND APLIED CONTRIBUTIONS IN THE DISSERTATION

1. As a result of an in-depth review of the specialized literature and the applicable regulatory framework, the role of accounting in the mining industry is substantiated as a primary information base and a factor for strategic management. The significance of comprehensive and consistent accounting representation of capital intensity, the long-term nature of assets, and the specific risks associated with future obligations, provisions for recultivation, and exploration and evaluation expenditures related to mineral resources – is analyzed and demonstrated as essential for long-term financial modeling and informed managerial decision-making in mining industry enterprises.

2. As a result of empirical research, the author argues that the integration of environmental and social costs, as well as non-financial indicators, is a necessary prerequisite for increasing transparency and adapting mining enterprises to the new regulatory requirements for sustainable reporting. An accounting approach for the recognition and measurement of the acquisition and use of land for extraction in enterprises engaged in the quarrying of stone, sand, and clay is systematized.

3. The capitalisation of costs for the acquisition of mining areas as non-current assets is substantiated, together with the application of the unit-of-production method or the functional method of depreciation, linked to the depletion of geological reserves. The time-limited use of land through restricted real rights and contractual arrangements is analysed as an economically appropriate mechanism for ensuring control over a key production resource, accompanied by the assumption of long-term environmental obligations. The recognition of concession rights as a separate intangible asset, clearly distinguished from tangible assets, leasing arrangements, and current expenses, is conceptually justified. With a view to achieving more reliable cost calculation, effective internal control, and a more

comprehensive presentation of the economic dimensions of mining activities, a model is proposed for integrating environmental costs and recultivation obligations into the cost of extraction.

4. Based on a Gap analysis, an author's benchmarking study of good practices, and applied research conducted in Bulgarian enterprises engaged in the quarrying of stone, sand, and clay, the need for improving their accounting systems is substantiated. It is demonstrated that integrating environmental protection costs into financial reporting requires a precise differentiation and accurate accounting treatment of environmental CAPEX and OPEX, as well as the systematic recognition of provisions for recultivation and decommissioning.

5. As a result of the practical study, gaps are identified in relation to homogeneous provisioning and insufficient analytical detail in the accounting of current environmental costs. These deficiencies highlight the need for technological integration of non-financial data with accounting systems. Proposals are formulated for incorporating environmental indicators into the budgeting process. This is achieved through the application of ECA within OPEX and adjusted NPV in CAPEX. The objective is to improve risk management, support investment decision-making, and ensure the financial coverage of future environmental commitments.

VII. LIST OF PUBLICATIONS OF THE DOCTORAL STUDENT

Article:

1. **Marinova, M.** Sustainability accounting in the enterprises of the mining industry – integration into the strategic approach. Годишен Almanac Annual Almanac "Scientific Research of PhD Students", 16th Doctoral Scientific Session. Issue XVI - 2023, Book 19, p. 378-391, https://almanahnid.uni-svishtov.bg/title.asp?title=3058

Conference papers:

1. Chipriyanova G., **Marinova M.,** AUTHOR FULL NAMES: Chipriyanova, Galina (58553580700); Marinova, Miglena (58582853100) 58553580700; 58582853100, Opportunities and Challenges in Modeling an Environmental Management System (2023) Vide. Tehnologija. Resursi - Environment, Technology, Resources, 1, pp. 38 - 43, DOI: 10.17770/etr2023vol1.7245 DOCUMENT TYPE: Conference paper OPEN ACCESS: All Open Access; Bronze Open Access; Green Open Access, **SOURCE: Scopus**
2. **Marinova, M.** Accounting aspects of provisions in the enterprises of the extractive industry business. Conference proceedings. Jubilee international scientific and practical conference *Challenges for finance and economic accounting in conditions of multiple crises*, 9-10 November 2023, Svishtov, p. 415-420.
3. **Marinova, M.** Accounting trends and challenges in the extractive industry. Conference proceedings. International scientific forum *Global and national business transformations – proactive management, financial-accounting and planning solutions*, 25-26 October 2024, Svishtov, p. 202-206.

4. Chipriyanova, G., Ivanova-Kuzmanova, G., **Marinova, M.** Accounting treatment of waste in the context of mining industry. Accounting, digitalization, sustainability – science and practice, Volume I, S., Academic Publishing house – UNWE, 2025, ISBN: 978-619-232-899-3, p. 560-570.
5. **Marinova, M.** Reporting for environmental protection and restoration expenses and provisioning (practical aspects in the mining industry). Conference proceedings. International scientific forum "Corporate solutions for economic development – strategic planning, reporting and sustainability", 24-25 October 2025, Svishtov, Publishing house „Tsenov", 2025, p. 257-264

VIII. RERENCE OF MEETING THE MINIMUM NATIONAL REQUREMENTS FOR OBTAINING THE EDUCATIONAL AND SCIENTIFIC DEGREE OF DOCTOR

Indicator	Points
Group of indicators A. ***Indicator 1. Dissertation for awarding the educational and scientific degree of doctor.***	
Accounting information support for effective management of mining industry enterprises	50
The dissertation has been discussed, and a defense procedure has been opened.	
Group of indicators G. *Sum of indicators from 4 ∂o 10*	
6. Articles and papers published in peer-reviewed scientific journals indexed and abstracted in internationally recognized databases	
Chipriyanova G., **Marinova M.** AUTHOR FULL NAMES: Chipriyanova, Galina (58553580700); Marinova, Miglena (58582853100) 58553580700; 58582853100 Opportunities and Challenges in Modeling an Environmental Management System (2023) Vide. Tehnologija. Resursi - Environment, Technology, Resources, 1, pp. 38 - 43, DOI: 10.17770/etr2023vol1.7245 DOCUMENT TYPE: Conference paper OPEN ACCESS: All Open Access; Bronze Open Access; Green Open Access, **SOURCE: Scopus**	15
7. Articles and papers published in unreferenced journal with scientific reviewing or published in edited collective volumes	
Marinova, M. Sustainability accounting in the enterprises of the mining industry – integration into the strategic approach. Годишен Almanac Annual Almanac "Scientific Research of PhD Students", 16th Doctoral Scientific Session. Issue XVI - 2023, Book 19, p. 378-391, https://almanahnid.uni-svishtov.bg/title.asp?title=3058	10
Chipriyanova G., **Marinova M.** AUTHOR FULL NAMES: Chipriyanova, Galina (58553580700); Marinova, Miglena (58582853100) 58553580700; 58582853100	15

Opportunities and Challenges in Modeling an Environmental Management System (2023) Vide. Tehnologija. Resursi - Environment, Technology, Resources, 1, pp. 38 - 43, DOI: 10.17770/etr2023vol1.7245 DOCUMENT TYPE: Conference paper OPEN ACCESS: All Open Access; Bronze Open Access; Green Open Access, **SOURCE: Scopus**	
Marinova, M. Accounting aspects of provisions in the enterprises of the extractive industry business. Conference proceedings. Jubilee international scientific and practical conference Challenges for finance and economic accounting in conditions of multiple crises, 9-10 November 2023, Svishtov, p. 415-420.	10
Marinova, M. Accounting trends and challenges in the extractive industry. Conference proceedings. International scientific forum Global and national business transformations – proactive management, financial-accounting and planning solutions, 25-26 October 2024, Svishtov, p. 202-206.	10
Chipriyanova, G., Ivanova-Kuzmanova, G., **Marinova, M.** Accounting treatment of waste in the context of mining industry. Accounting, digitalization, sustainability – science and practice, Volume I, S., Academic Publishing house – UNWE, 2025, ISBN: 978-619-232-899-3, p. 560-570.	3
Marinova, M. Reporting for environmental protection and restoration expenses and provisioning (practical aspects in the mining industry). Conference proceedings. International scientific forum "Corporate solutions for economic development – strategic planning, reporting and sustainability", 24-25 October 2025, Svishtov, Publishing house „Tsenov", 2025, p. 257-264	10
Total points – sum of the indicators from 4 òo 10	***58***
Required points – sum of indicators from 4 до 10	**30**

VIII. DECLARATION OF ORIGINALITY OF THE DISSERTATION

The dissertation in a volume 215 pages under the title: “Accounting information support for effective management of mining industry enterprises“ represents the author’s own scientific production. It uses original ideas, texts and visualization through figures, tables, and formulas, and complies with all the requirements of the Copyright and Related Rights Act by duly citing and referring to other authors’ thoughts, as well as data, including:

1. The results achieved in the dissertation and the contributions made are original and have not been borrowed from research and publications in which the author has no participation.

2. The information presented by the author in the form of copies of documents and publications, personally compiled reports, etc. Corresponds to the objective truth.

3. The scientific results that have been obtained, described, and/or published by other authors are duly and comprehensively cited in the bibliography.

27 January 2026

Doctoral student: ……

(Miglena Marinova)